FOREST RESEARCH REPORT

NOVA SCOTIA DEPARTMENT OF LANDS AND FORESTS
P.O. BOX 68, TRURO, N.S. B2N 5B8

No. 18, November 1989

CONTROLLING COMPETING VEGETATION WITH LOWER THAN RECOMMENDED RATES OF GLYPHOSATE: A COMPARISON OF TWO TRIALS

INTRODUCTION

Vision® (active ingredient: glyphosate 356 grams/litre) is a herbicide that will provide control of a variety of broadleaf species (NSLF, 1988; Sutton, 1978). Currently, Vision® is registered in Canada for site preparation and conifer release by ground and aerial applications (CPPA, 1986).

Previous trials carried out in Nova Scotia (NSLF, 1988; NSLF, 1989) indicated that various target species could be controlled at lower than recommended rates of Vision®. The product label recommends using 6.0 litres of product per hectare for *Acer* spp. and *Rubus* spp. and from 3.0 to 6.0 l/ha for the control of other brush species. The purpose of this report is to: 1) summarize the results of a trial to verify the minimum rates of Vision® required to control various species of competition and 2) compare these results with those of a similar trial previously established at Vanderveens Road (NSLF, 1989).

SITE DESCRIPTION

Located adjacent to Granny Road, Pictou County (45°23'N, 62°48'W), the experimental site was clearcut and a portion of it was prepared (brush raked and burned) in 1984 and planted with Norway spruce multipot stock in 1985. The remaining portion was site prepared in the same manner in 1985 and planted with red spruce multipot stock in 1986. Before treatment with Vision®, the site was covered by a uniform immature cover of raspberry, grass and hardwood sprouts (primarily red maple with lesser amounts of sugar maple, birch and aspen).

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FUNDED UNDER CANADA/NOVA SCOTIA FOREST RESOURCE DEVELOPMENT AGREEMENT

Nova Scotia Department of Lands and Forests

Forestry Canada Forêts Canada

METHODS

Ten blocks, each approximately two hectares in size, were selected for treatment and randomly assigned to one of nine different application rates of Vision®. Rates were chosen to range from 0.52 litres of product per hectare to 4.69 l/ha plus a non-sprayed control block. The increment between treatments was 0.52 l/ha. All but one of the blocks were treated on September 14, 1986 by helicopter. The block receiving 0.52 l/ha was treated on September 10. The swath width was 22 m and the total solution applied in single passes was 56 l/ha. The temperature ranged from 7 to 13° C and wind speeds from 0 to 6 km/hr during application.

Vegetation was assessed during the summers of 1987 and 1988, one and two years following herbicide treatment. Twenty assessment plots were established systematically within each treatment block starting at a randomly selected point. Concentric plots having radii of 1.8 m and 0.6 m were used to assess woody vegetation and non-woody types of vegetation, respectively. At the time of assessment, the mean heights and percent cover of each species of competing vegetation were recorded. In addition, the height, root collar diameter (RCD), vigour and leader length of the closest planted seedling to the centre of each plot were measured.

The ability of the various treatments to control overhead competing vegetation was evaluated by the following competition index:

$$CI = H \times C$$

where,
- CI = Competition Index
- H = Average height (metres) of a given species
- C = % of ground covered by the same species.

An analysis of variance (ANOVA, $p = 0.05$) was performed to test for significant differences in CI among treatment levels. Anova's were also performed on Arcsine transformed CI. The results of these ANOVA's were essentially the same as those from untransformed data. The results from the untransformed data are reported here. Where significant differences were found, a Duncan's multiple range test ($p = 0.05$) was used to differentiate between individual treatment rates. In addition, non-linear regression analysis was used to relate average CI to rate of Vision® applied. An exponential model of the following form was used.

$$CI = a * e^{(b * Rate)}$$

where,
- CI = Average Competition Index for all plots within a given treatment level.
- rate = Litres of Vision® applied per hectare
- e = Naperian Constant = 2.718...
- a, b = regression coefficients

The effect of Vision® on seedling heights and diameters will be summarized in a later report, following the fifth-year remeasurement.

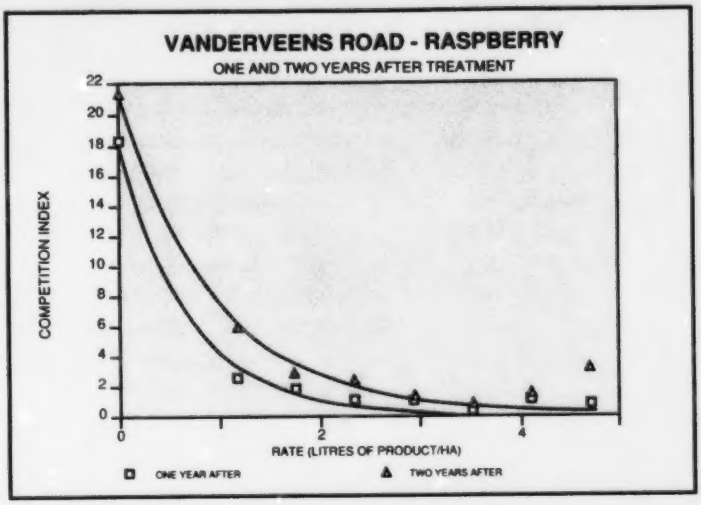
RESULTS AND DISCUSSION

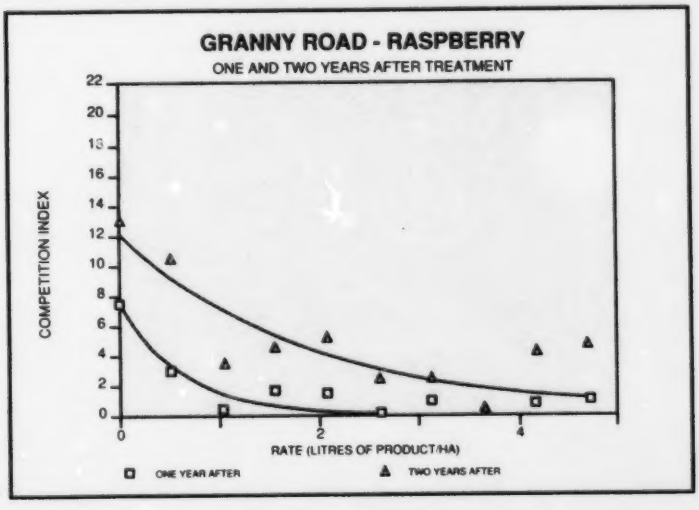
Early results (one and two years after application) indicate that lower than recommended rates of Vision® were effective in controlling the major species of competing vegetation at the Granny Road site (i.e. raspberry, grass and red maple). The results from this trial are similar to those recorded in a previous trial at Vanderveens Road (NSLF, 1989). Appendices I through IV show the average percent cover, heights and competition index for each of the species groups by herbicide rate, one and two years after spraying at both Vanderveens Road and Granny Road. These appendices also show the results of the Duncan's Multiple Range tests performed on competition index. The ANOVA results are summarized in Appendices V through IX.

TARGET SPECIES

Raspberry

All treatments resulted in a reduction in the competition index for this species compared to the control at Granny Road (Figure 1). In general, except for the highest treatment rates, the greater the amount of Vision® applied, the greater the control provided. All treatments resulted in a significant reduction in the competition index in both the first and second year after treatment (Appendix I and II) as compared to the control. However, in the second year, the competition index in the block treated with the lowest treatment rate (0.52 l/ha) was found to be





Regression equation C.I. = $a*e^{(b*rate)}$ where:					
		a	b	R^2	S_{yx}
Granny Rd.	(1 yr after)	7.38	-1.65	0.89	0.79
Granny Rd.	(2 yrs after)	12.14	-0.54	0.71	2.20
Vanderveens Rd.	(1 yr after)	18.24	-1.48	0.99	0.72
Vanderveens Rd.	(2 yrs after)	21.51	-1.04	0.97	1.31

R^2 = adjusted coefficient of determination
S_{yx} = standard error of the estimate

Figure 1. Competition index for raspberry at Granny Road and Vanderveens Road by rate of application.

significantly greater than all of the other treated blocks. There was no significant difference between any of the other treatment rates (Appendix II).

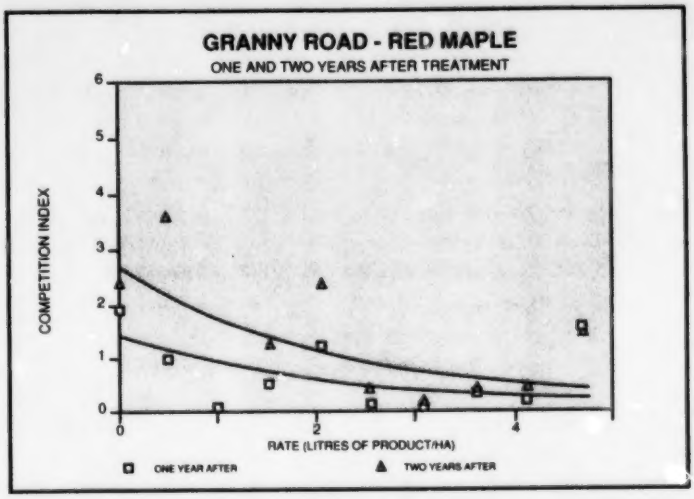
Similarly, at the Vanderveens Road site, the competition indices for raspberry were also reduced with an increase in the application rate (Figure 1). One and two years after herbiciding (1985 and 1986), the degree of competition as measured by CI for the control blocks was significantly greater than those of the treated blocks (Appendix III and IV). Two years after treatment, the block treated with 1.17 l/ha (the lowest treatment rate in this trial) had a significantly higher CI than for the blocks treated with 2.9, 3.5 and 4.1 l/ha (Appendix IV).

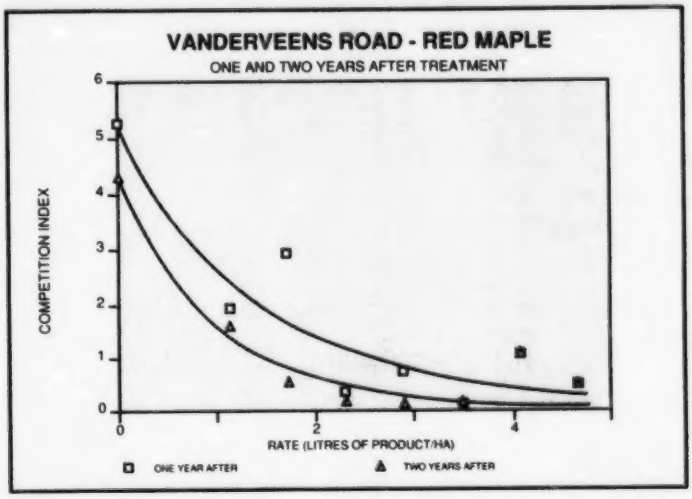
In both experiments, the CI was slightly higher for the herbicide application rates greater than 4 l/ha as compared to the CI for rates between 3 and 4 l/ha. However, these differences were not found to be significant.

Red Maple

The effect of the different rates of Vision® on red maple was similar to that of raspberry (Figure 2). All treated blocks at Granny Road had a competition index lower than the control one year after treatment (Appendix I - 1987). However, there was no significant difference in mean CI between the control and the treated blocks. During the second year assessment (1988) the highest competition index was found in the block treated with the lowest rate of Vision® (0.52 l/ha) (Appendix II). The competition index in this block was found to be significantly greater than those in the blocks treated with 1.04, 2.60, 3.12, 3.65 and 4.17 l/ha.

At Vanderveens Road, the treatment induced reduction in CI for red maple was more pronounced than at Granny Road. For both the one and two year assessments (1985 and 1986) at the Vanderveens Road site, the competition index for the control blocks was significantly greater than those in any of the treated blocks. There were no significant differences in mean CI among the various application rates of Vision® (See Appendices III and IV).





Regression equation C.I. = $a*e^{(b*rate)}$ where:					
		a	b	R^2	S_{xx}
Granny Rd.	(1 yr after)	1.44	-0.44	0.19	0.65
Granny Rd.	(2 yrs after)	2.70	-0.43	0.37	1.01
Vanderveens Rd.	(1 yr after)	5.21	-0.64	0.85	0.72
Vanderveens Rd.	(2 yrs after)	4.38	-0.98	0.91	0.46

R^2 = adjusted coefficient of determination
S_{xx} = standard error of the estimate

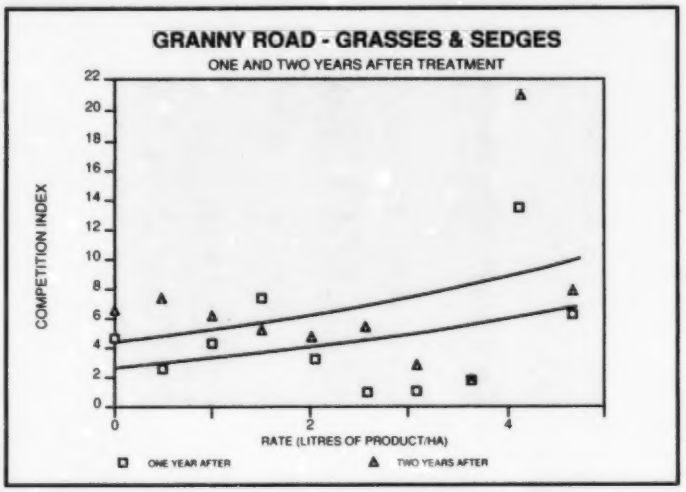
Figure 2. Competition index for red maple at Granny Road and Vanderveens Road by rate of application.

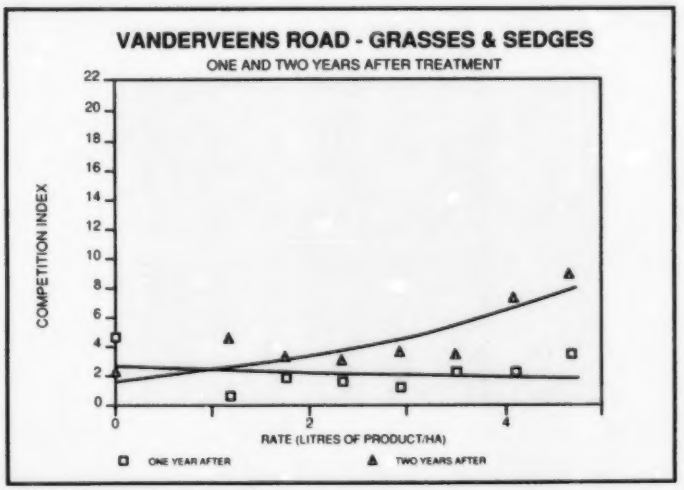
Grasses and Sedges

The overall pattern of CI versus treatment rate was inconsistent at Granny Road for grasses and sedges. However, the blocks treated with the higher rates of Vision® tended to have the higher CI values (Figure 3). In fact, the highest CI for these species was found in the block treated with 4.17 l/ha, both one and two years after treatment.

At Vanderveens Road, one year after treatment, there were no major differences in competition index for these species due to treatment level (Figure 3). Two years after treatment, competition index increased with treatment rate. The competition index for the block treated with the highest rate of Vision® (4.67 l/ha) was significantly greater than for all but the 4.08 l/ha rate.

Both trials showed that grasses and sedges rapidly re-invade sites treated with Vision®, especially at the higher rates two years after treatment.


GRANNY ROAD - GRASSES & SEDGES
ONE AND TWO YEARS AFTER TREATMENT
COMPETITION INDEX
RATE (LITRES OF PRODUCT/HA)
ONE YEAR AFTER
TWO YEARS AFTER


VANDERVEENS ROAD - GRASSES & SEDGES
ONE AND TWO YEARS AFTER TREATMENT
COMPETITION INDEX
RATE (LITRES OF PRODUCT/HA)
ONE YEAR AFTER
TWO YEARS AFTER

Regression equation C.I. = $a*e^{(b*rate)}$ where:

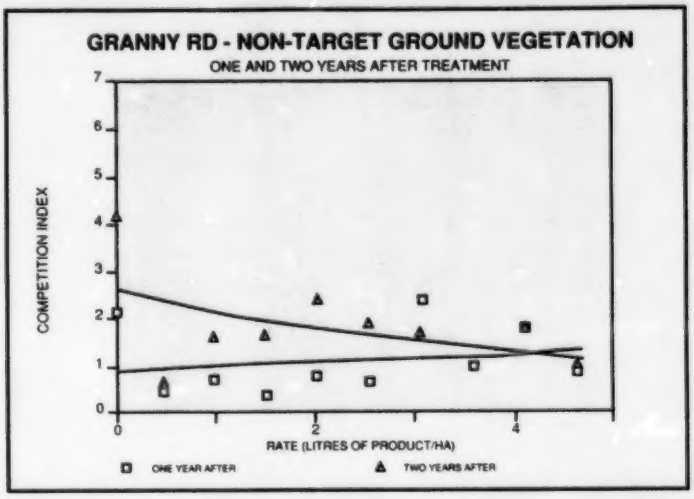
		a	b	R^2	S_{yx}
Granny Rd.	(1 yr after)	2.68	0.20	0.09	3.87
Granny Rd.	(2 yrs after)	4.45	0.17	0.09	5.29
Vanderveens Rd.	(1 yr after)	2.85	-0.08	0.03	1.42
Vanderveens Rd.	(2 yrs after)	2.01	0.30	0.67	1.43

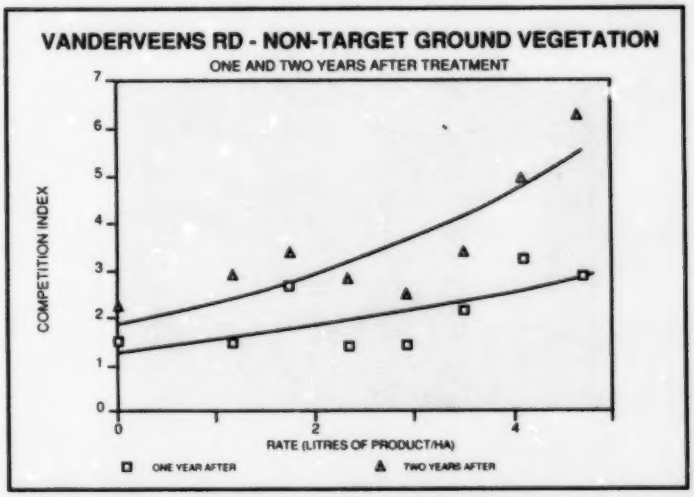
R^2 = adjusted coefficient of determination
S_{yx} = standard error of the estimate

Figure 3. Competition index for grasses and sedges at Granny Road and Vanderveens Road by rate of application

NON-TARGET GROUND VEGETATION

One year after treatment at Granny Road, the competition indices for the non-target species (i.e. bunchberry, ferns, mosses, willow herb, aster, wild lily of the valley and pearly everlasting) were fairly uniform with respect to application rate. Two years after, the highest competition index was evident in the control block. In contrast, at Vanderveens Road, competition index increased as treatment rate increased.


GRANNY RD - NON-TARGET GROUND VEGETATION
ONE AND TWO YEARS AFTER TREATMENT
COMPETITION INDEX
RATE (LITRES OF PRODUCT/HA)
ONE YEAR AFTER
TWO YEARS AFTER


VANDERVEENS RD - NON-TARGET GROUND VEGETATION
ONE AND TWO YEARS AFTER TREATMENT
COMPETITION INDEX
RATE (LITRES OF PRODUCT/HA)
ONE YEAR AFTER
TWO YEARS AFTER

Regression equation C.I. = $a^{*}e^{(b^{*}rate)}$ where:

		a	b	R^2	S_{yx}
Granny Rd.	(1 yr after)	0.93	0.06	0.02	0.81
Granny Rd.	(2 yrs after)	2.58	-0.18	0.23	0.93
Vanderveens Rd.	(1 yr after)	1.33	0.17	0.43	0.62
Vanderveens Rd.	(2 yrs after)	1.89	0.23	0.72	0.75

R^2 = adjusted coefficient of determination
S_{yx} = standard error of the estimate

Figure 4. Competition index for non-target species at Granny Road and Vanderveens Road by rate of application.

SUMMARY

The major results of the two trials reported here are as follows:

1) Raspberry competition at Granny Road was significantly reduced for at least 2 years after treatment with rates between 1.04 and 4.69 l/ha of Vision®. At Vanderveens Road, competition was reduced for the same length of time when treated with rates between 1.17 and 4.67 l/ha of Vision®.

2) Good control of red maple at the Granny Road site was achieved with rates between 2.60 and 4.69 l/ha (2.33 to 4.67 l/ha at Vanderveens Road).

3) The competition indices for grasses and sedges generally decreased with increased amounts of Vision® applied in the year of treatment. However, one and two years after treatment, grasses and sedges rapidly re-invaded sprayed sites, especially the blocks treated with the higher rates (4.17 and 4.69 l/ha). In these blocks there was actually more grass competition than in the controls due to reduced competition from the taller vegetation (i.e. red maple and raspberry).

4) Treatment essentially caused a taller layer of target vegetation (i.e. raspberry and red maple) to be replaced by a shorter layer of vegetation (i.e. grass, sedge and ground vegetation).

LITERATURE CITED

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NSLF, 1988. Efficacy of glyphosate in controlling competing vegetation in Nova Scotia. N.S. Dept. of Lands and Forests. Forest Research Report No. 3. 8 pp.

NSLF, 1989. Controlling competing vegetation with lower than recommended rates of glyphosate. N.S. Dept. of Lands and Forests. Forest Research Report No. 8. 7 pp.

Sutton, R.F. 1978. Glyphosate herbicide: an assessment of forestry potential. Forestry Chronicle 54: 24-28.

APPENDIX I

Average percent cover, average height (metres) and Competition Index for the major species groups by treatment rate at Granny Road, one year after treatment.

Treatment (l/ha)	Red Maple			Raspberry			Grasses & Sedges			Other Ground Vegetation			All Species Combined		
	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI
Control	2.2	0.55	1.97*	16.3	0.34	7.53a	11.3	0.35	4.80a	8.0	0.25	2.12*	38.6	0.31	16.59b
0.52	1.7	0.52	1.02	8.1	0.20	2.89b	9.1	0.21	2.55a	3.2	0.16	0.43	23.0	0.25	7.10a
1.04	0.2	0.37	0.06	2.3	0.14	0.43b	13.0	0.21	4.32a	4.4	0.12	0.68	20.3	0.20	5.54a
1.56	1.5	0.38	0.53	6.9	0.14	1.59b	9.7	0.26	7.36ab	3.2	0.14	0.34	23.8	0.19	10.59ab
2.08	1.5	0.47	1.22	4.9	0.21	1.43b	7.9	0.30	3.14a	3.8	0.17	0.75	19.0	0.24	6.77a
2.60	0.4	0.30	0.14	1.2	0.10	0.12b	6.5	0.13	0.76a	3.8	0.13	0.59	12.9	0.15	1.77a
3.12	0.2	0.28	0.06	3.5	0.15	0.83b	3.0	0.25	0.86a	13.4	0.15	2.30	20.6	0.18	4.13a
3.65	0.8	0.31	0.33	1.0	0.13	0.18b	3.1	0.28	1.61a	7.4	0.13	0.97	12.5	0.18	3.12a
4.17	0.6	0.27	0.19	2.4	0.18	0.63b	42.8	0.28	13.40b	14.5	0.15	1.75	60.7	0.20	16.02b
4.69	2.0	0.49	1.48	2.7	0.23	0.80b	21.3	0.26	6.28ab	6.9	0.14	0.79	33.8	0.23	9.54ab

a,b - Significantly different CI levels (according to Duncan's Multiple Range Test, p=0.05) for a particular species are indicated by different letters.

CI - Competition Index (% cover * height) average for all plots.

* - No significant CI differences between rates (according to ANOVA, p=0.05)

APPENDIX II

Average percent cover, average height (metres) and Competition Index for the major species groups by treatment rate at Granny Road, two years after treatment.

Treatment (l/ha)	Red Maple			Raspberry			Grasses & Sedges			Other Ground Vegetation			All Species Combined		
	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI
Control	2.3	0.83	2.42ab	37.2	0.32	13.00b	19.2	0.30	6.68a	12.4	0.33	4.20*	71.5	0.37	26.41d
0.52	4.1	0.78	3.59b	28.6	0.30	10.44b	22.7	0.33	7.29a	3.0	0.24	0.61	58.9	0.41	22.29cd
1.04	0.1	0.50	0.05a	14.0	0.21	3.34a	22.4	0.25	6.18a	7.0	0.19	1.58	44.0	0.20	11.28ab
1.56	2.0	0.55	1.25ab	13.9	0.27	4.44a	15.1	0.36	5.26a	4.4	0.26	1.64	35.8	0.31	12.68ab
2.08	2.7	0.64	2.34ab	18.8	0.23	5.12a	13.1	0.32	4.71a	7.9	0.22	2.32	43.1	0.31	14.76bc
2.60	0.7	0.28	0.39a	6.0	0.26	2.27a	18.1	0.33	5.51a	6.6	0.25	1.84	32.5	0.28	10.40ab
3.12	0.2	0.53	0.11a	7.9	0.23	2.37a	6.8	0.40	2.79a	11.0	0.16	1.64	26.1	0.26	6.94ab
3.65	0.6	0.55	0.43a	1.8	0.17	0.42a	7.7	0.38	1.74a	4.3	0.17	1.07	14.5	0.24	3.72a
4.17	0.9	0.40	0.38a	11.8	0.29	3.93a	40.2	0.48	20.76b	4.1	0.23	1.78	57.1	0.36	26.87d
4.69	2.6	0.36	1.40ab	12.3	0.31	4.47a	22.0	0.32	7.75a	6.8	0.18	0.91	44.5	0.26	14.71bc

a,b,c,d - Significantly different CI levels (according to Duncan's Multiple Range Test, p=0.05) for a particular species are indicated by different letters.

CI - Competition Index (% cover * height) average for all plots.

* - No significant CI differences between rates (according to ANOVA, p=0.05)

APPENDIX III

Average percent cover, average height (metres) and Competition Index for the major species groups by treatment rate at Vanderveens Road, one year after treatment.

Treatment (l/ha)	Red Maple			Raspberry			Grasses & Sedges			Other Ground Vegetation			All Species Combined		
	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI
Control	5.40	0.40	5.25b	37.98	0.34	18.30b	13.55	0.22	4.92*	4.80	0.15	1.48*	67.98	0.44	34.04c
1.17	2.45	0.25	1.95a	9.23	0.15	2.56a	5.08	0.06	0.74	7.78	0.09	1.48	25.70	0.28	7.28ab
1.75	3.18	0.28	2.90ab	7.68	0.14	1.82a	8.65	0.11	2.03	7.10	0.10	2.74	31.75	0.32	13.04b
2.33	1.00	0.15	0.32a	4.75	0.10	1.06a	10.85	0.06	1.62	8.50	0.08	1.40	27.53	0.18	5.52a
2.92	1.00	0.18	0.70a	4.13	0.10	1.06a	6.90	0.10	1.30	6.10	0.12	1.39	21.70	0.25	6.43ab
3.50	0.43	0.12	0.12a	1.80	0.06	0.33a	13.00	0.11	2.28	13.35	0.12	2.14	30.30	0.20	5.90a
4.08	1.38	0.16	1.07a	5.03	0.07	1.08a	14.98	0.13	2.34	18.83	0.16	3.22	42.20	0.21	8.62ab
4.67	0.78	0.20	0.43a	3.23	0.12	0.67a	17.33	0.15	3.58	16.95	0.14	2.88	40.53	0.23	8.45ab

a,b,c - Significantly different CI levels (according to Duncan's Multiple Range Test, p=0.05) for a particular species are indicated by different letters.

CI - Competition Index (% cover * height) average for all plots.

* - No significant CI differences between rates (according to ANOVA, p=0.05)

APPENDIX IV

Average percent cover, average height (metres) and Competition Index for the major species groups by treatment rate at Vanderveens Road, two years after treatment.

Treatment (l/ha)	Red Maple			Raspberry			Grasses & Sedges			Other Ground Vegetation			All Species Combined		
	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI	% Cover	Height	CI
Control	3.78	0.44	4.37b	51.58	0.36	21.62c	11.70	0.17	2.53a	7.70	0.19	2.35a	79.55	0.40	34.09d
1.17	2.80	0.22	1.61a	17.18	0.17	6.05b	14.73	0.18	4.97ab	19.23	0.13	2.97a	55.90	0.24	16.30bc
1.75	1.30	0.21	0.54a	9.78	0.20	2.77ab	13.93	0.17	3.55ab	24.50	0.14	3.38a	56.73	0.25	14.39abc
2.33	0.60	0.10	0.17a	9.13	0.17	2.28ab	9.58	0.13	3.15a	22.60	0.12	2.88a	44.68	0.22	10.06ab
2.92	0.50	0.10	0.11a	6.55	0.14	1.33a	12.50	0.18	3.89ab	17.25	0.12	2.55a	39.70	0.22	8.96a
3.50	0.45	0.10	0.11a	2.50	0.08	0.65a	10.88	0.21	3.60ab	24.88	0.15	3.33a	40.25	0.20	8.24a
4.08	0.88	0.11	1.04a	5.30	0.15	1.52a	20.15	0.27	7.44bc	29.43	0.19	4.95ab	58.28	0.28	15.79bc
4.67	0.83	0.15	0.46a	9.40	0.19	2.99ab	25.55	0.25	9.10c	23.30	0.24	6.17b	61.90	0.32	20.32c

a,b,c,d -Significantly different CI levels (according to Duncan's Multiple Range Test, p=0.05) for a particular species are indicated by different letters.

CI -Competition Index (% cover * height) average for all plots.

APPENDIX V

Anova's for Granny Road and Vanderveens Road : Raspberry
Competition Index by Treatment Level

Vanderveens Road 1985 : Raspberry

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	10342.4	1477.5	27.2	< 0.0005
Within Groups	312	16946.6	54.3		
Total	319	27288.9			

Vanderveens Road 1986 : Raspberry

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	13531.2	1933.0	30.5	< 0.0005
Within Groups	312	19760.3	63.3		
Total	319	33291.6			

Granny Road 1987 : Raspberry

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	890.6	99.0	3.2	0.0013
Within Groups	190	5881.1	31.0		
Total	199	6771.7			

Granny Road 1988 : Raspberry

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	2669.6	296.6	5.4	< 0.0005
Within Groups	190	10469.1	55.1		
Total	199	13138.8			

APPENDIX VI

Anova's for Granny Road and Vanderveens Road : Red Maple
Competition Index by Treatment Level

Vanderveens Road 1985 : Red Maple

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	857.6	122.5	3.1	0.0036
Within Groups	312	12360.5	39.6		
Total	319	13218.1			

Vanderveens Road 1986 : Red Maple

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	579.6	82.8	3.6	0.0009
Within Groups	312	7113.7	22.8		
Total	319	7693.2			

Granny Road 1987 : Red Maple

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	83.0	9.2	1.3	0.2402
Within Groups	190	1350.2	7.1		
Total	199	1433.2			

Granny Road 1988 : Red Maple

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	259.1	28.8	2.1	0.0348
Within Groups	190	2652.9	14.0		
Total	199	2912.0			

APPENDIX VII

Anova's for Granny Road and Vanderveens Road : Grasses & Sedges
Competition Index by Treatment Level

Vanderveens Road 1985 : Grasses & Sedges

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	
Between Groups	7	498.8	71.3	1.9	0.0680
Within Groups	312	11660.1	37.4		
Total	319	12158.9			

Vanderveens Road 1986 : Grasses & Sedges

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	1488.4	212.6	3.1	0.0038
Within Groups	312	21592.6	69.2		
Total	319	23081.0			

Granny Road 1987 : Grasses & Sedges

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	2640.8	293.4	2.1	0.0280
Within Groups	190	26047.0	137.1		
Total	199	28687.7			

Granny Road 1988 : Grasses & Sedges

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	4931.3	547.9	6.6	< 0.0005
Within Groups	190	15858.1	83.4		
Total	199	20769.4			

APPENDIX VIII

Anova's for Granny Road and Vanderveens Road : Other Ground Vegetation
Competition Index by Treatment Level

Vanderveens Road 1985 : Other Ground Vegetation

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	161.8	23.1	10.9	0.5298
Within Groups	312	8270.9	26.5		
Total	319	8432.5			

Vanderveens Road 1986 : Other Ground Vegetation

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	7	485.2	63.9	2.3	0.0298
Within Groups	312	9589.8	30.7		
Total	319	10075.0			

Granny Road 1987 : Other Ground Vegetation

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	91.8	10.2	1.7	0.0845
Within Groups	190	1120.0	5.9		
Total	199	1211.8			

Granny Road 1988 : Other Ground Vegetation

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	9	177.5	19.7	1.0	0.4379
Within Groups	190	3729.7	19.6		
Total	199	3907.2			

APPENDIX IX

Anova's for Granny Road and Vanderveens Road : All Species
Competition Index by Treatment Level

Vanderveens Road 1985 : All Species

Source	D.F.	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	7	25515.0	3645.0	17.8	<0.0005
Within Groups	312	63820.6	204.6		
Total	319	89335.6			

Vanderveens Road 1986 : All Species

Source	D.F.	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	7	19745.3	2820.8	14.0	<0.0005
Within Groups	312	62819.5	201.3		
Total	319	82564.8			

Granny Road 1987 : All Species

Source	D.F.	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	9	4660.3	517.8	3.0	0.0020
Within Groups	190	32291.0	170.0		
Total	199	36951.3			

Granny Road 1988 : All Species

Source	D.F.	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	9	11140.7	1237.9	7.4	<0.0005
Within Groups	190	31899.4	167.9		
Total	199	43040.1			

FOREST RESEARCH SECTION
FORESTRY BRANCH
N.S. DEPT. OF LANDS AND FORESTS

FOREST RESEARCH SECTION PERSONNEL

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